VOLUNTEER MONITORING OF MACROINVERTEBRATES IN THE PINELANDS: SAMPLING TECHNIQUES, TARGET GROUPS AND QAQC

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ABSTRACT

The focus areas for this project were several sub-watersheds within the Great Egg Harbor River (GEHR) basin, Watershed Management Area (WMA) #15 of the New Jersey Department of Environmental Protection (NJDEP). Inconsistencies in the Ambient Biomonitoring Network (AMNET) results versus other indicators of water quality in the NJ Pinelands have been pointed out by the scientific staff of the Pinelands Commission. NJDEP is now developing revised AMNET criteria for coastal plain streams. NJDEP also has proposed to make use of the Pinelands Commission databases on plants, fishes and anurans to assess water quality in the region (NJDEP 2003).

Faculty and undergraduate students of the Environmental Studies Program, Richard Stockton College, have been working with NJDEP, the Pinelands Commission and the Great Egg Harbor River Association to develop revised approaches to invertebrate bioassessment suitable for use by volunteers

In spring of 2002, we developed a conceptual model of water quality in the GEHR basin based on existing water quality and biotic data. We developed sub-watershed maps, showing the percent of developed land in each. In summer 2002, we collected samples of macroinvertebrates from diverse substrates and measured pH and specific conductance at each stream site. Biological samples were identified in the lab, and multivariate statistical analysis was performed on the data. The percent of developed land seemed to be the best predictor of water quality and biological impairment.

Based on the preliminary samples and analysis, the macroinvertebrate fauna found on woody debris in the streams was selected as the best target for accurate biological sampling. In June 2003, we collected additional, replicated samples from woody debris at twelve selected sites. Three samples of approx. 1-2 meters of woody debris, 5-35 mm diameter, were collected at each site, and subjected to preliminary analysis.

These studies point to the macroinvertebrate fauna of woody debris as a reasonable target for volunteer monitoring. Further refinement of the criteria is needed to accurately discriminate among sites showing different degrees of impairment. We are working to develop a hierarchical framework for Quality Assurance/Quality Control (QAQC) that will enable volunteers, Stockton College and a cooperating research university to link the collection, identification and analysis of macroinvertebrate samples. This will enable each level to specialize in the tasks best suited to it. We are also exploring alternative methods for collecting and assessing macroinvertebrates, including light trap sampling.

INTRODUCTION
The Great Egg Harbor River

A low-gradient, blackwater river system in the outer Coastal Plain of New Jersey.

• Waters are naturally acidic and colored by humic substances.

• The substrate is peat in the perennial sections of most headwater streams and sand or gravel in higher order segments.

• Macroinvertebrate assemblages differ in structure and function from piedmont and mountain streams

Great Egg Harbor River
WMA #15
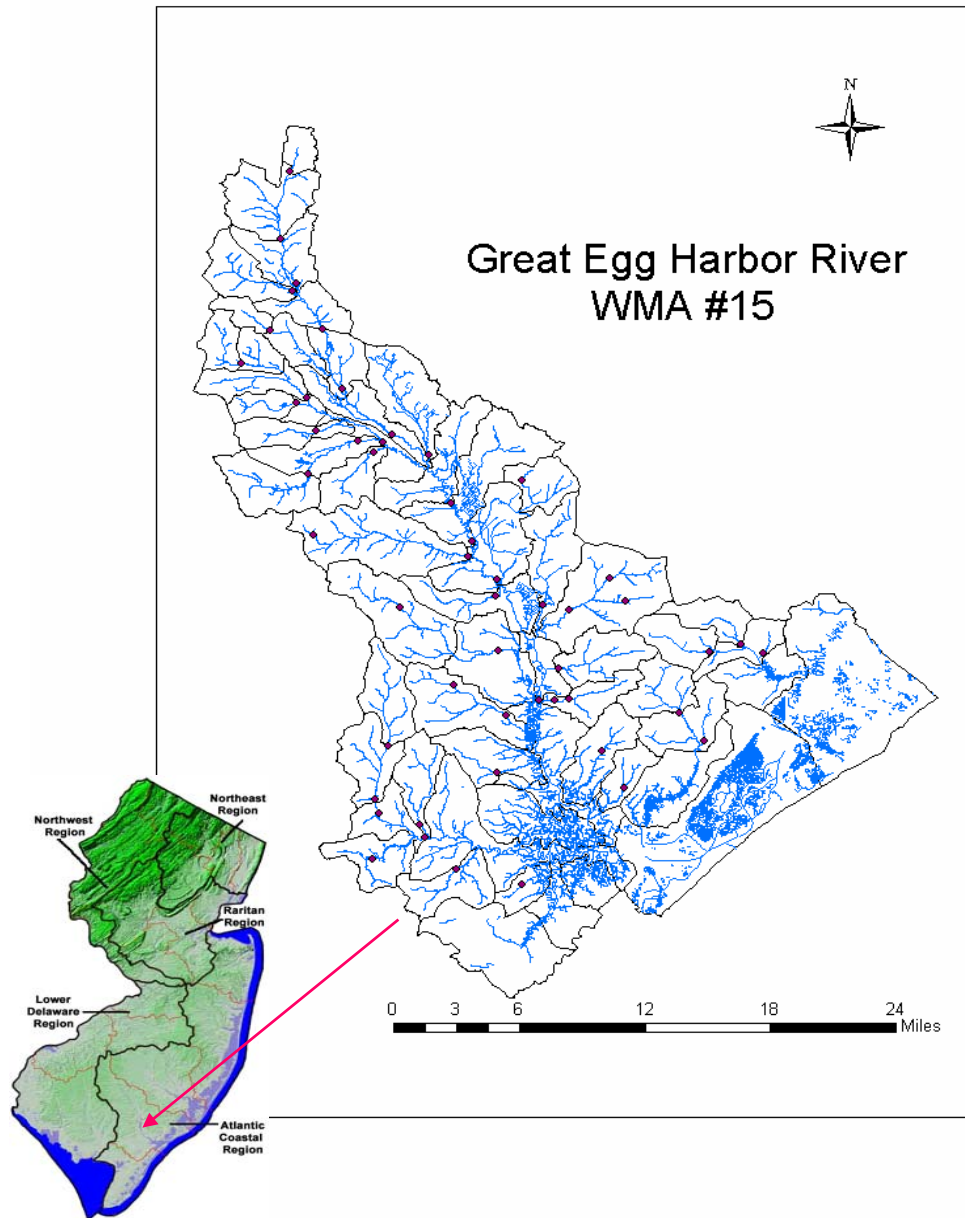
Points shown are
AMNET biomonitoring
network sampling sites.

Conceptual Model

Landuse change

$\downarrow$
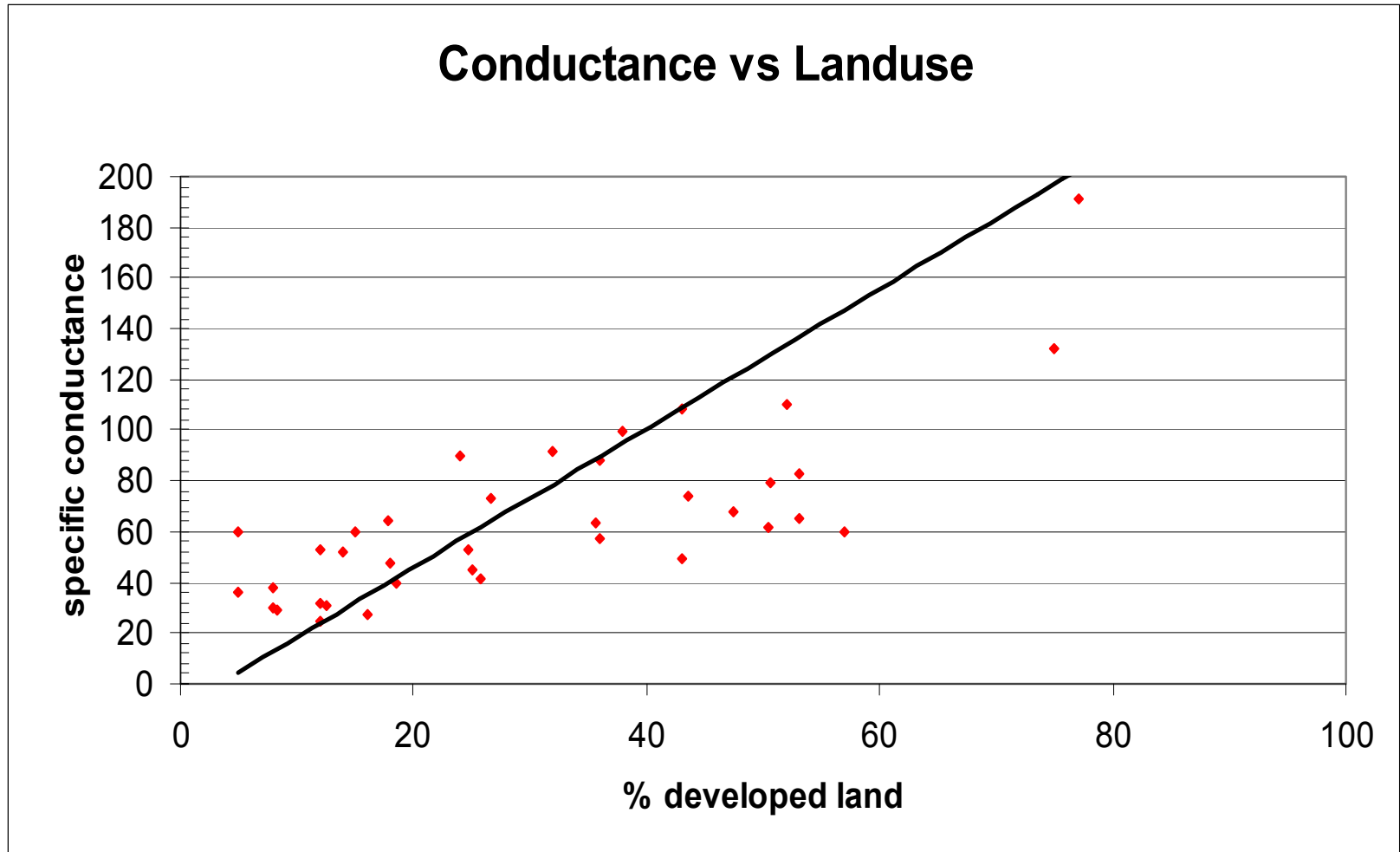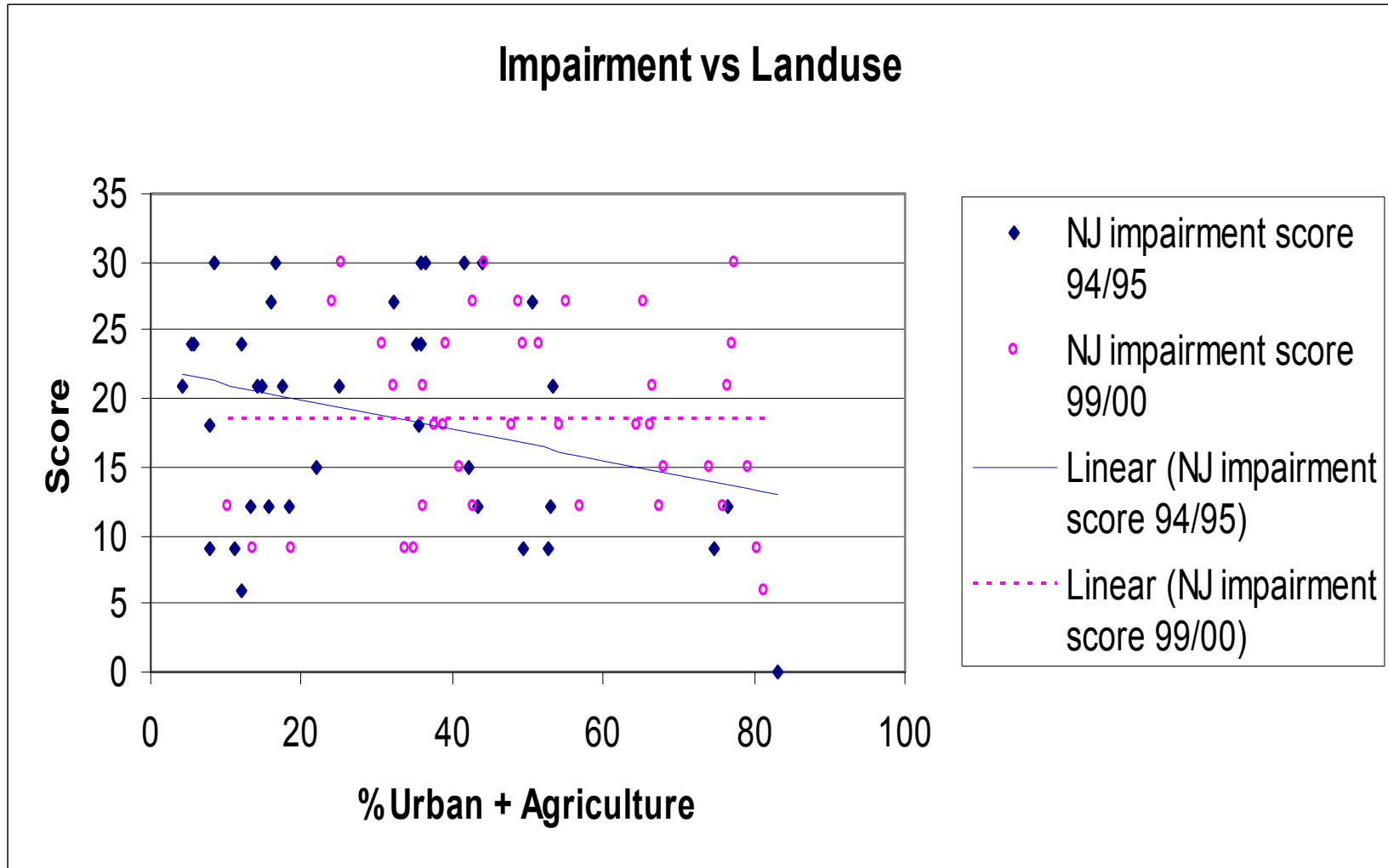
Altered chemistry (pH and Specific Conductance)

$\downarrow$

Changes in biota

Chemical changes resulting from changed landuse
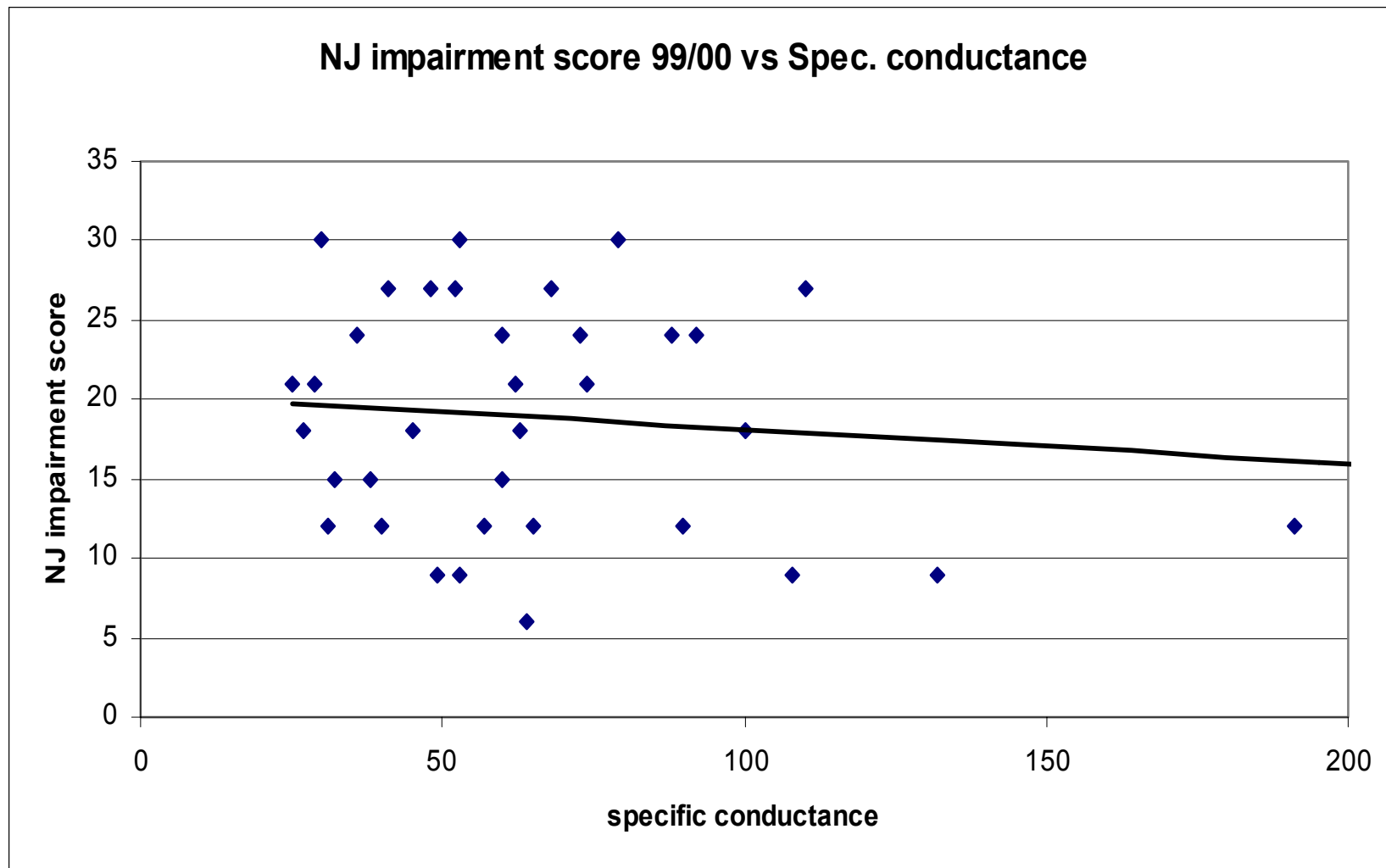

pH vs Landuse

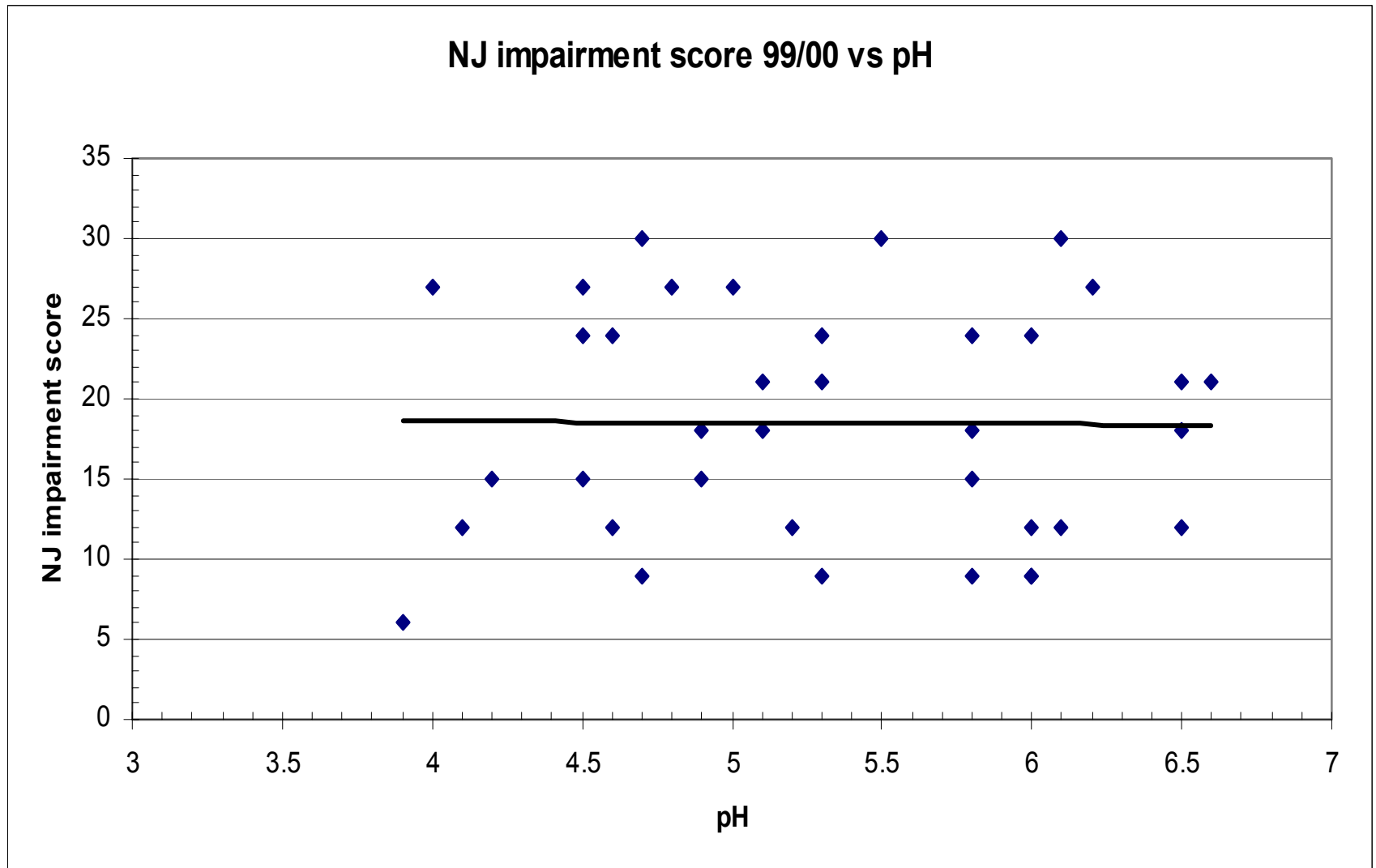# Chemical changes resulting from changed landuse
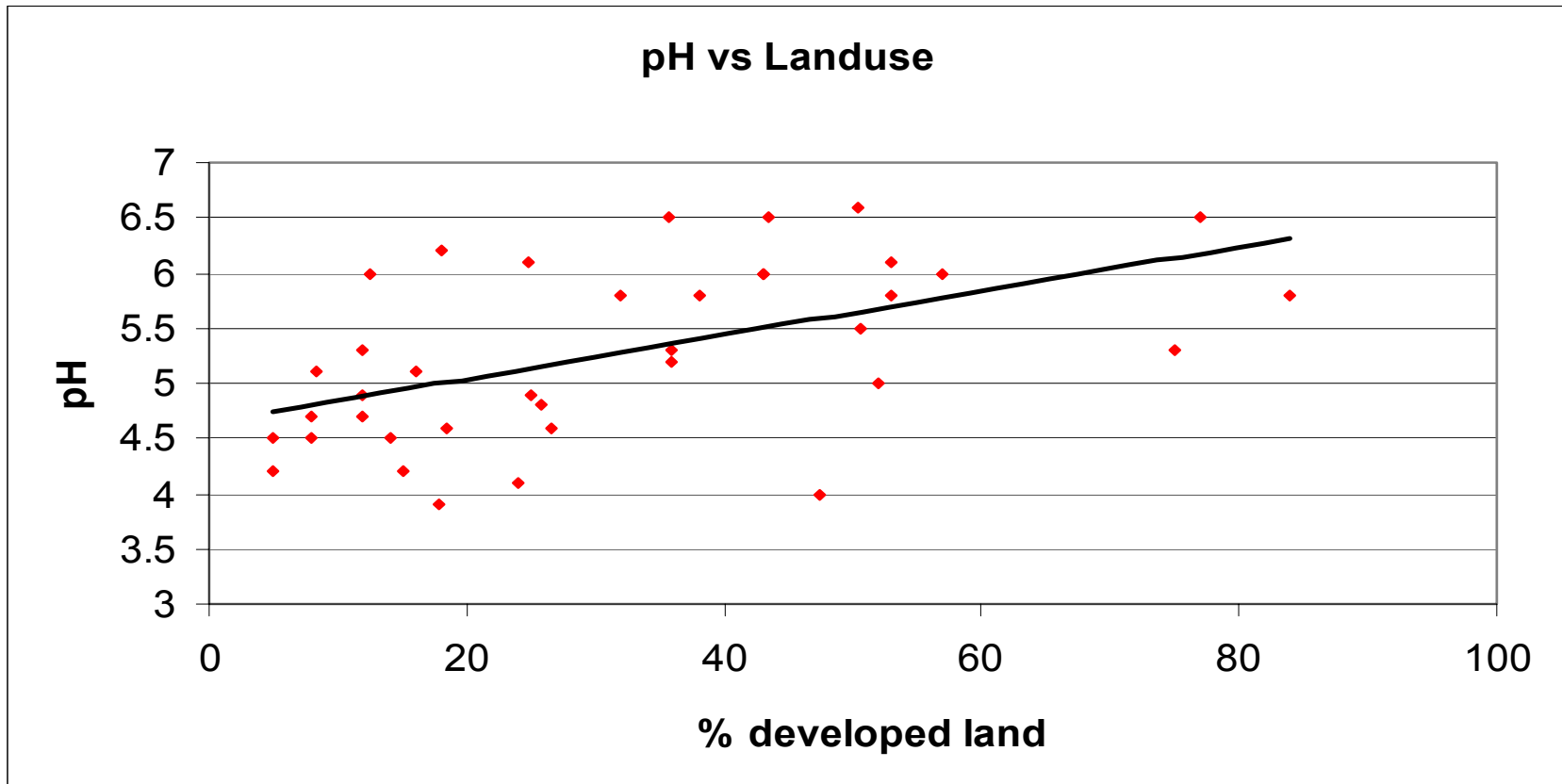
Conductance vs Landuse

AMNET DATA COMPARES POORLY TO OTHER MEASURES OF WATER QUALITY

AMNET DATA vs OTHER MEASURES OF WATER QUALITY, CONT.

NJ impairment score 99/00 vs Spec. conductance

AMNET DATA vs OTHER MEASURES OF WATER QUALITY, CONT.

NJ impairment score 99/00 vs pH

PROBLEM: REFINING THE BIOMONITORING PROTOCOL

- You might ask, as we have, why bother to sample macroinvertebrates, when a pH or conductivity meter can give a good indication whether a stream has impaired water quality, and when the NJDEP and the Pinelands Commission are proposing to use plants and fishes as alternative biological criteria

- Invertebrate biomonitoring is useful as both a check on other methods and a way to involve non-professionals, including science students and local volunteers.

- Clearly, a better metric for analyzing invertebrate samples is needed. What works in trout streams in northern New Jersey does not work in the Pine Barrens.

Snags are key habitat in blackwater streams

Lack of large stones and alternating riffles and pools mean that invertebrates must either occupy peat and mud, which tend to be anoxic, or sand which is often unstable. Gravel is limited to the wider sections downstream and places where road fill has washed in. Thus in rivers like the GEHR, sunken sticks and logs provide the best substrate for macroinvertebrates.

2003 FIELD RESEARCH METHODS

Three samples of approximately 1-2 meters total length of woody debris, 5-35 mm diameter, were collected at each site, washed with a soft scrub brush over an 0.5 mm sieve and examined under a stereo microscope for any remaining invertebrates.

All invertebrates were preserved in 70% ethanol with 5% glycerin.

Samples were sorted and most invertebrates were identified to family and genus (midges were identified to family only as were some non-insects). For preliminary analysis, taxa were grouped under classes and orders.

Data were analyzed using multivariate statistics (detrended correspondence analysis [DCA] and TWINSPAN grouping) with the program PC-ORD (version 4 for Windows, MJM Software Design).

Specific conductance (μS) and pH were measured in the field, supplemented by preliminary values supplied by the NJ Pinelands commission.
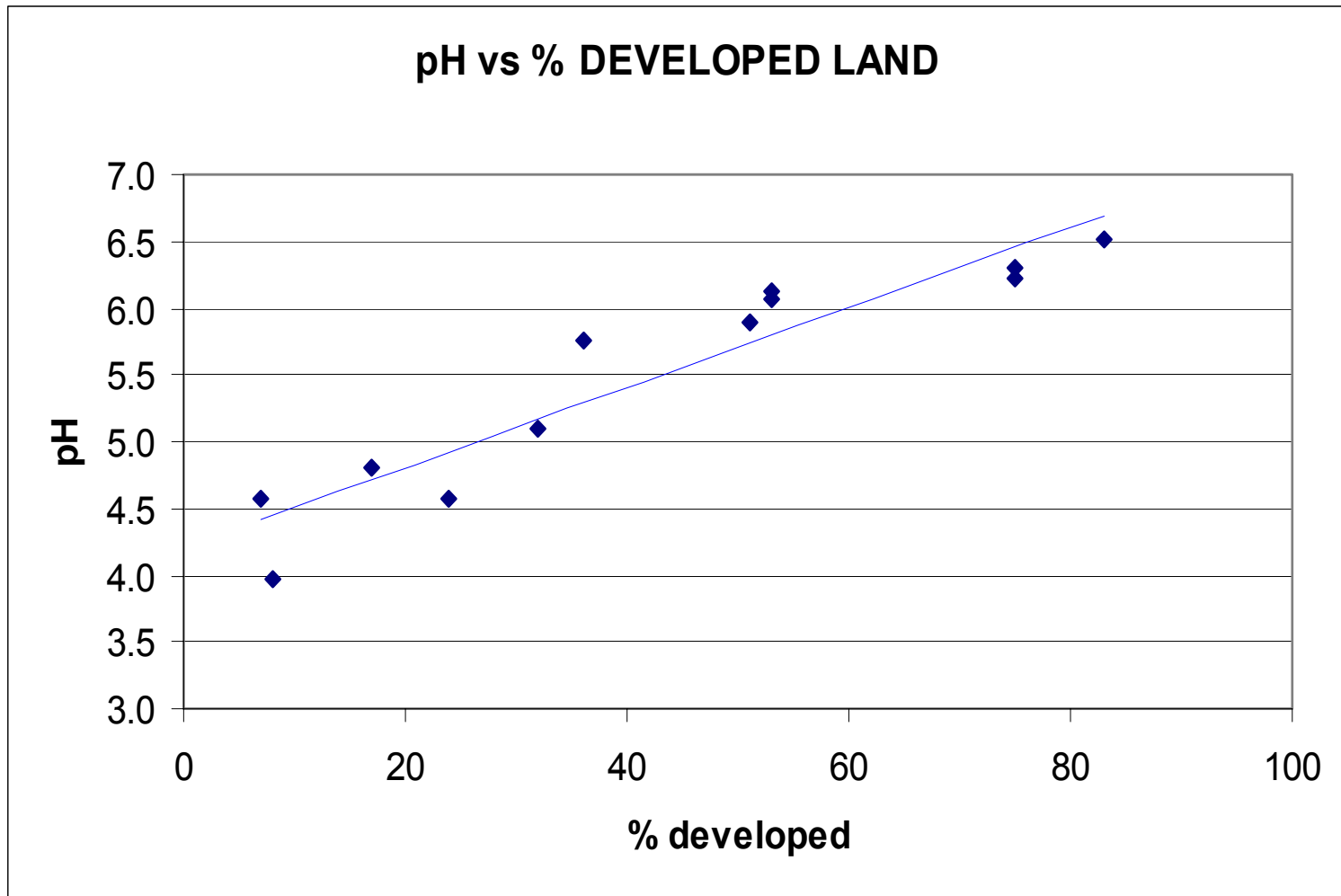
PRELIMINARY RESULTS 2003
WATER CHEMISTRY

pH vs SPECIFIC CONDUCTANCE
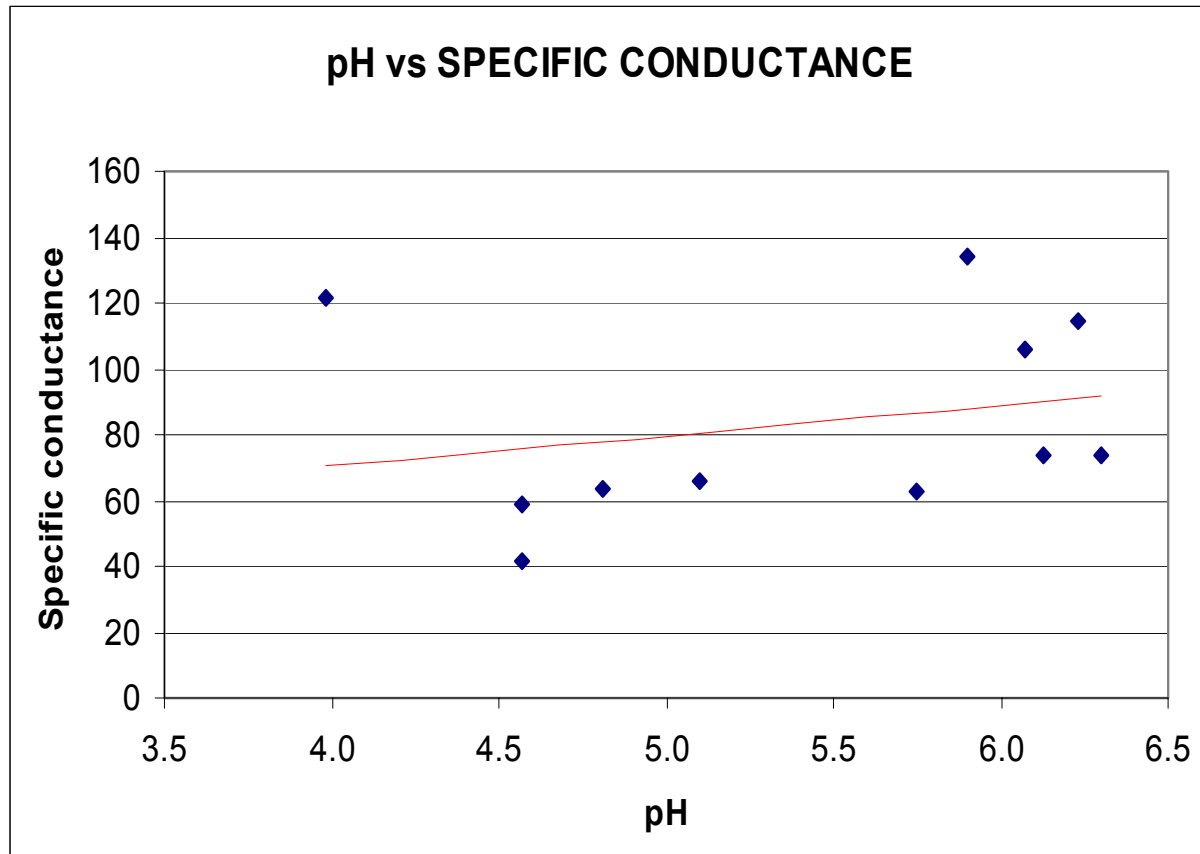
When pH is very low, as at White Oak Branch (median pH 4) specific conductance may rise (median SC 122). The sewage affected site, Deep Run 1 (pH 6.5, SC 695) is omitted from this chart.
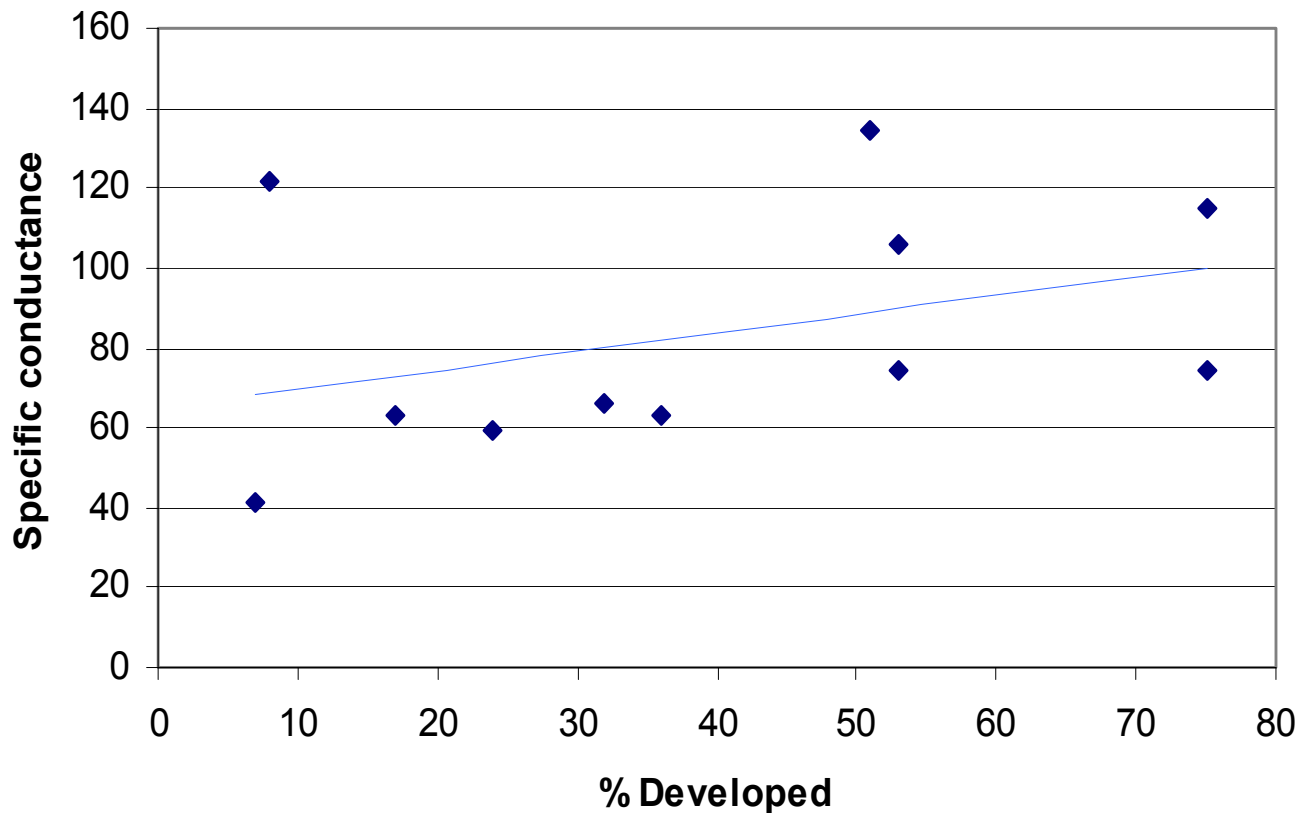
PRELIMINARY RESULTS 2003
LANDUSE AND WATER QUALITY

pH vs % DEVELOPED LAND

PRELIMINARY RESULTS 2003
LANDUSE AND WATER QUALITY

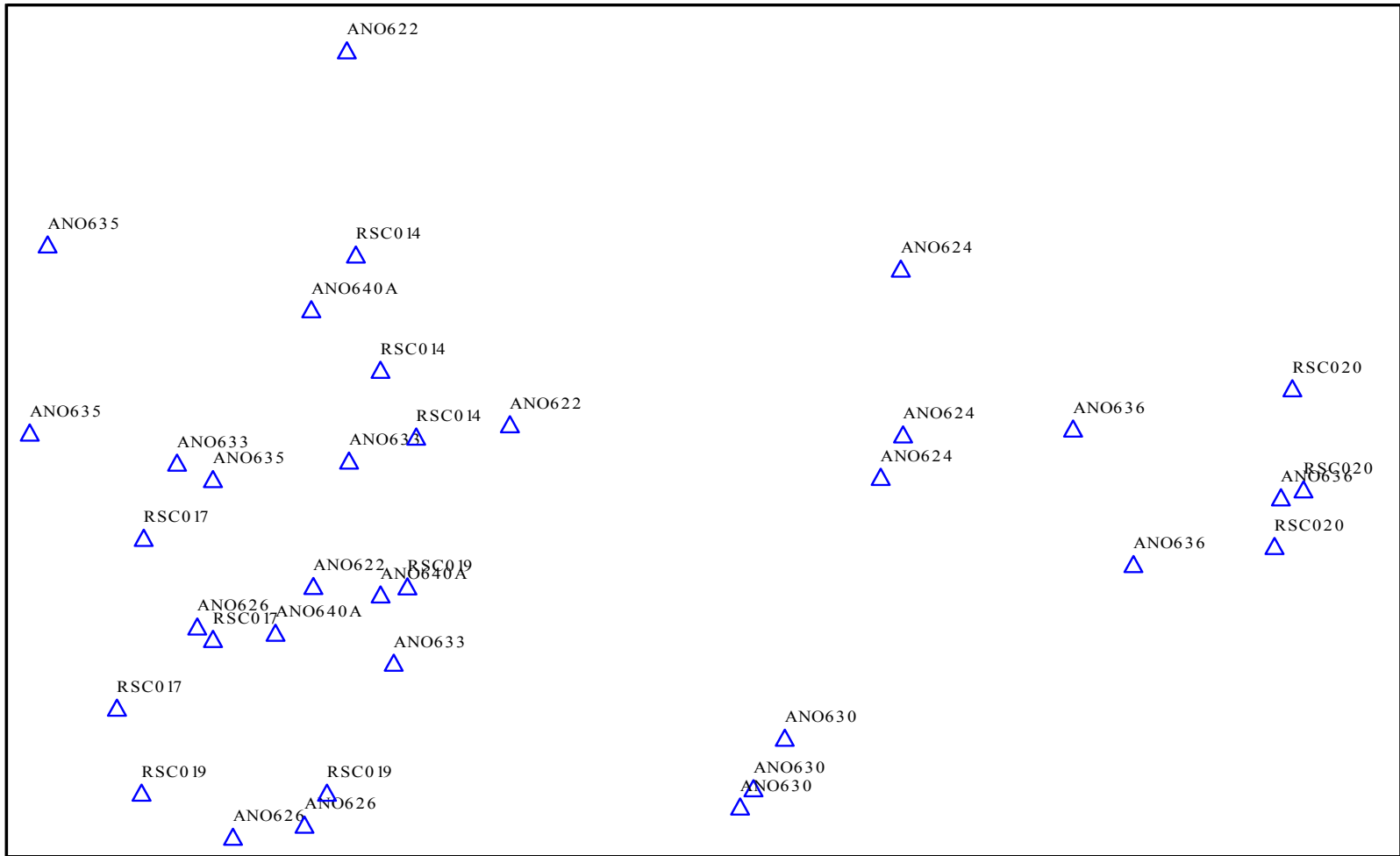**SPECIFIC CONDUCTANCE VS LANDUSE**

White Oak Branch (% developed 8, SC 120) is anomalous. Deep Run site 1, which has a sewage treatment plant outfall, is omitted (83% developed, SC 695). The relationship is less clear than for pH and requires further investigation.
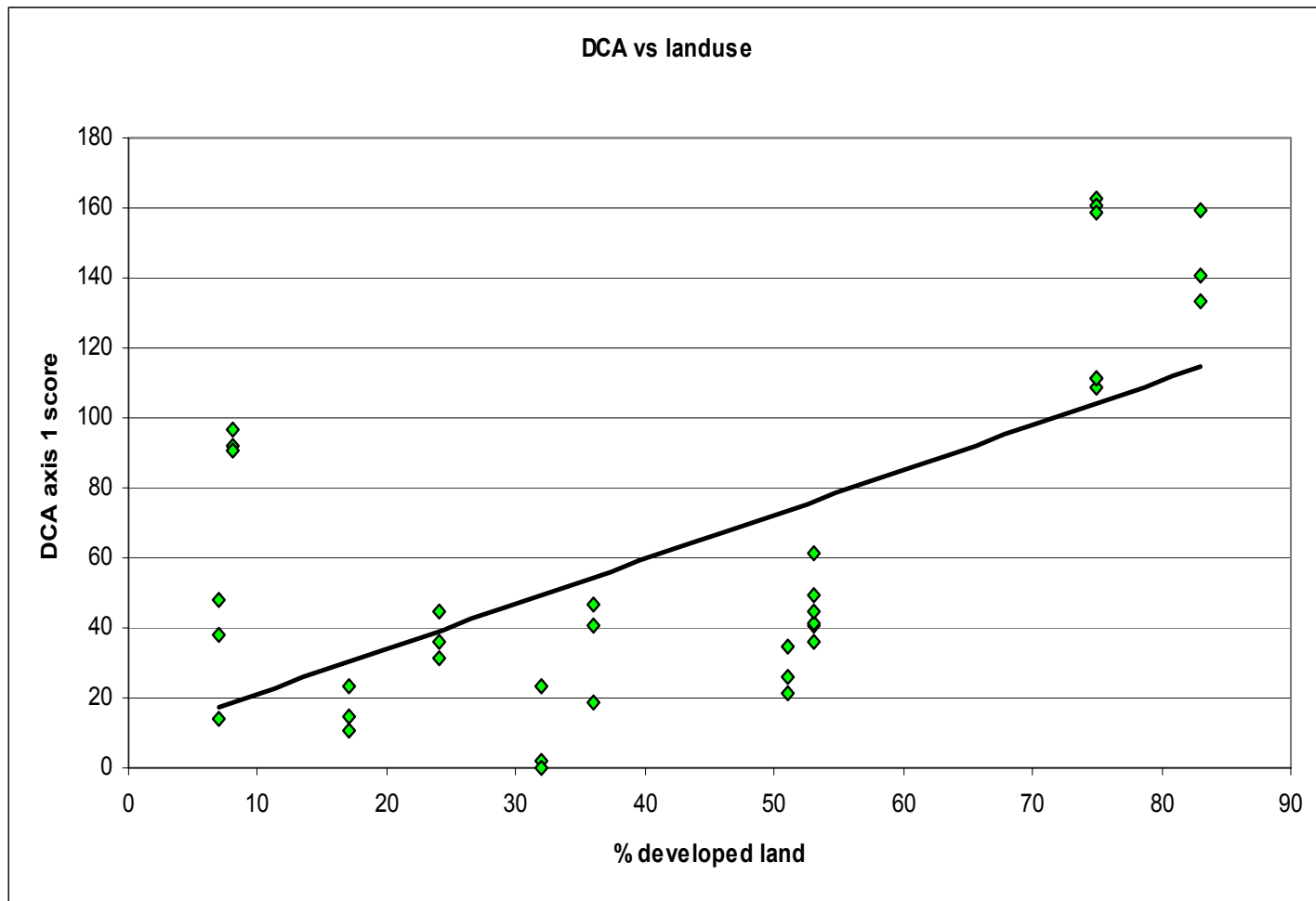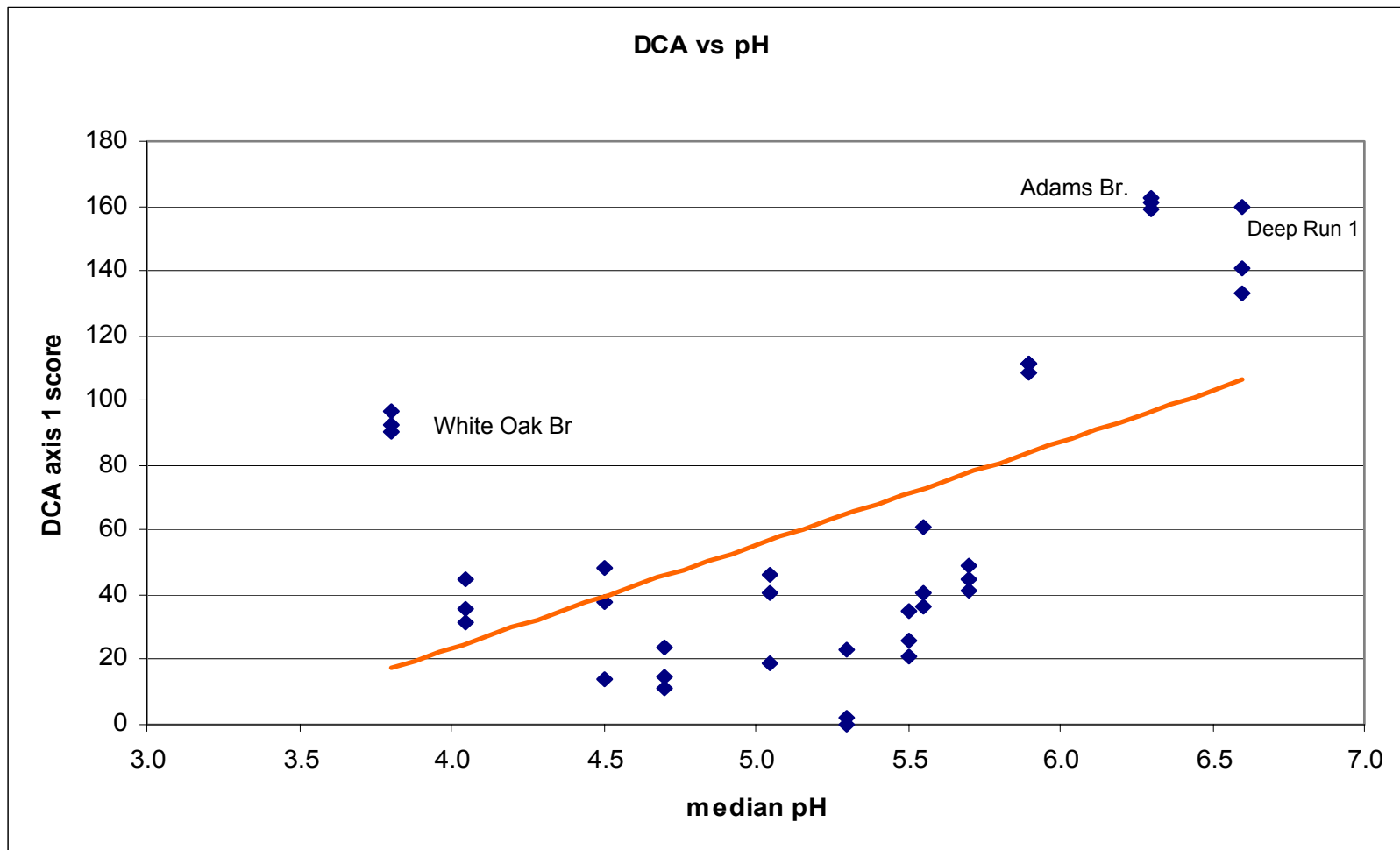
DCA analysis of results 2003

9oct03DCA

Preliminary results 2003, cont.
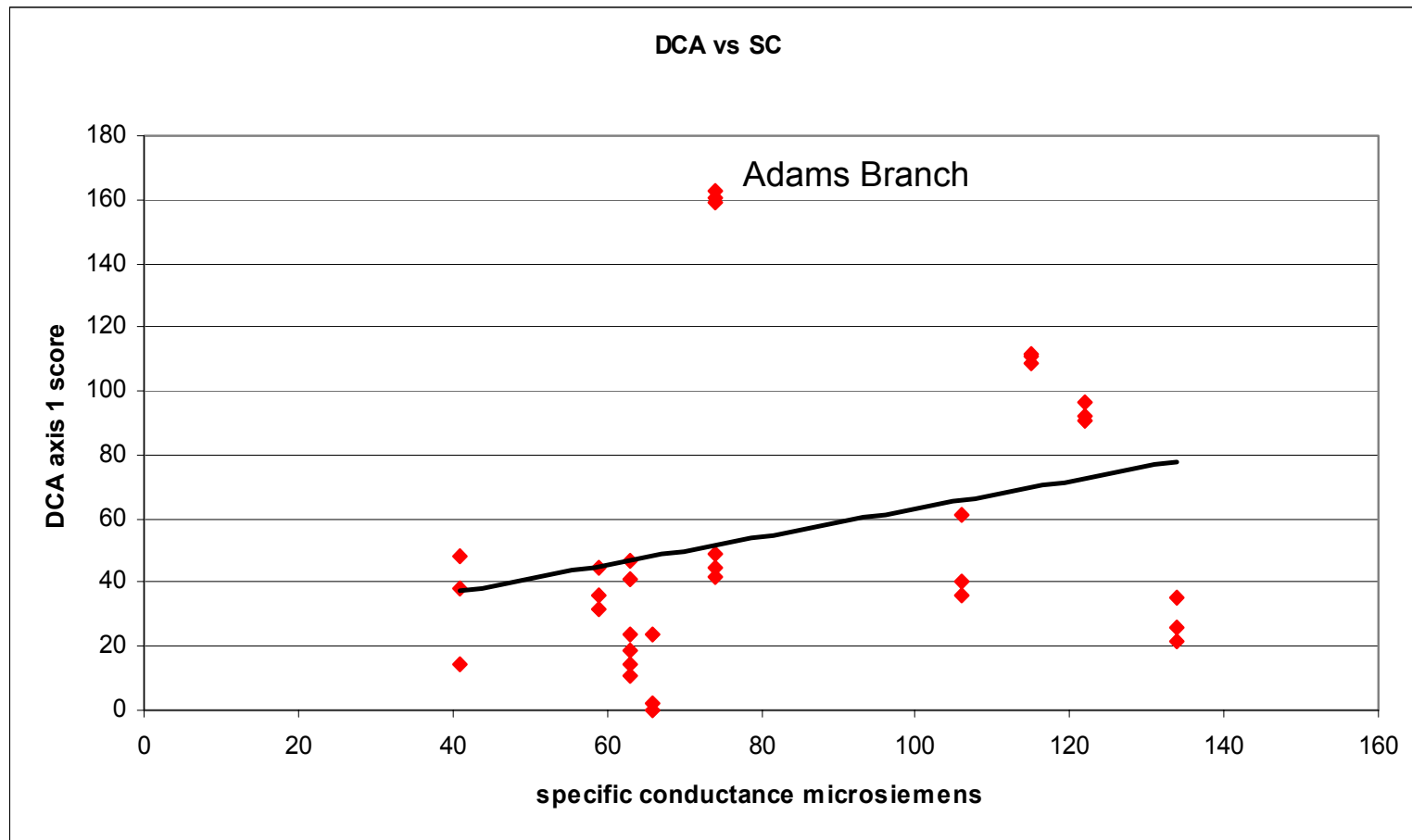

DCA vs landuse

The three samples for White Oak Branch lie off the general trend (DCA score ~100, 8% developed).

Preliminary results 2003, cont.

Preliminary results 2003, cont.

CONCLUSIONS AND FURTHER STUDY

- The preliminary results from 2003 suggest that the fauna of woody debris may be a reasonable target for volunteer biomonitoring.

- Further analysis is needed to devise a metric that will discriminate among sites that vary in chemistry and degree of physical modification. The importance of particular taxa at the family and generic level remains to be investigated.

- We continue to try to devise a reliable way to sample stream invertebrates and interpret results. We hope to find a method that can be applied with minimal training by anyone interested in helping protect the GEHR.

- We are preparing selected specimens for long term storage in the American Museum of Natural History's Monel cryopreservation facility, to enable future researchers to study high-quality samples of invertebrates from the GEHR.